

# From Oil Refinement to Baby Formula

In February 2002, Mead Johnson Nutritionals, a subsidiary of the Bristol-Myers Squibb Company, introduced a new baby formula to the U.S. market. The product, Enfamil Lipil, was the first infant formula approved for sale in the United States to contain DHA (docosahexaenoic acid) and ARA (arachidonic acid). These are two essential fatty acids also found in human breast milk.

This advance in nutrition was helped along by the research of Peter Wan, a chemical engineer in the Commodity Utilization Research Unit at the Southern Regional Research Center (SRRC) in New Orleans, Louisiana. Wan has worked for the Agricultural Research Service for 12 years and has spent much of that time developing innovative separation and purification processes to enhance use of cottonseed oil and its co-products.

No, cottonseed oil isn't used in the baby formula, but Wan's work with the oil has a definite link to the technology that allowed DHA and ARA to be added to the formula as supplements.

## Back Story

"Before I came to SRRC in 1990, I worked for Kraft Foods," says Wan. At the time, Kraft had a collaborative research agreement with Martek Biosciences Corporation, a small entrepreneurial company based in Columbia, Maryland. "Scientists at Martek were searching for new, natural sources of omega-3 fatty acids. At Kraft, we were studying ways to process and refine oil rich in these nutrients so that we could use it in Kraft products in the future," he says.

Omega-3 fatty acids are essential nutrients that the body does not produce itself. Their consumption may help reduce the risk of coronary heart disease, and they are found in high concentrations in nerve cell membranes and the retina.

"The best-known source of omega-3 fatty acids is oil from coldwater fish,"

says Wan. "Unfortunately, fish oil is highly unsaturated and oxidizes quickly, meaning it goes bad very fast and smells fishy, which is objectionable to consumers."

Martek scientists wanted to find a source of omega-3 fatty acids that could be added to foods without imparting a fishy flavor. Their search led them to the bottom of the food chain. David J. Kyle, co-founder and then-vice president of research and development for Martek,

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**Technician Audrey Waggoner uses an automated colorimeter to measure the color of cottonseed oil that has been refined, bleached, and deodorized.**

says, "It turns out that coldwater fish don't synthesize omega-3 fatty acids. These nutrients actually come from algae. Our company screened many algal species to find those that are rich in DHA and ARA, and we also found a way to harvest them in the lab."

At Kraft, Wan began looking for ways to segregate the oil from the algae. His

group was supposed to come up with an oil processing and refining scheme and look for potential uses for the end product. "It was during this phase of the research that I left Kraft to join ARS," he says.

## Algal Gold and the Cotton Connection

One of Wan's first projects at SRRC was finding ways to improve the quality of cottonseed oil, which is difficult to refine because it contains natural pigments and variable amounts of free fatty acids. High amounts of free fatty acids can lower the quality of cottonseed oil, making it darker in color and less stable.

"We tried the conventional method of adding a caustic to remove the pigments and free fatty acids, but the quality of usable oil produced was less than I had hoped," says Wan. Because he wasn't successful with conventional methods, he decided to try something different.

"We added more free fatty acids to the oil and then added the caustic," explains Wan. Though the method doesn't seem logical, it worked. The oil was lighter in color than before, and all its existing free fatty acids as well as those that Wan had supplied were essentially removed.

Soon after Wan began using his unconventional refining process, Kyle called him to discuss challenges his team was facing in refining algal oil. By this time, Kraft had dropped out of the project. Under a confidentiality agreement between ARS and Martek, Wan shared his findings about cottonseed oil refinement. He suggested that Martek try the process on algal oil using a range of conditions comparable to those he had used on cottonseed oil.

According to Kyle, Martek researchers had independently yet simultaneously developed a processing method similar to Wan's, but they were still having problems. With Wan's advice and further experimentation, Martek was able to successfully segregate and process oil rich in omega-3 fatty acids from the algae.

“Peter gave us suggestions that helped during an important phase of our research,” says Kyle.

### New Product for Formula-Fed Babies

To mimic mothers’ milkfat, infant formulas are made from a mixture of vegetable fats and oil blends such as palm olein, soy, coconut, and high-oleic sunflower oil. For years, however, these formulas lacked certain omega-3 fatty acids such as DHA because unstable fish oil was the only available source.

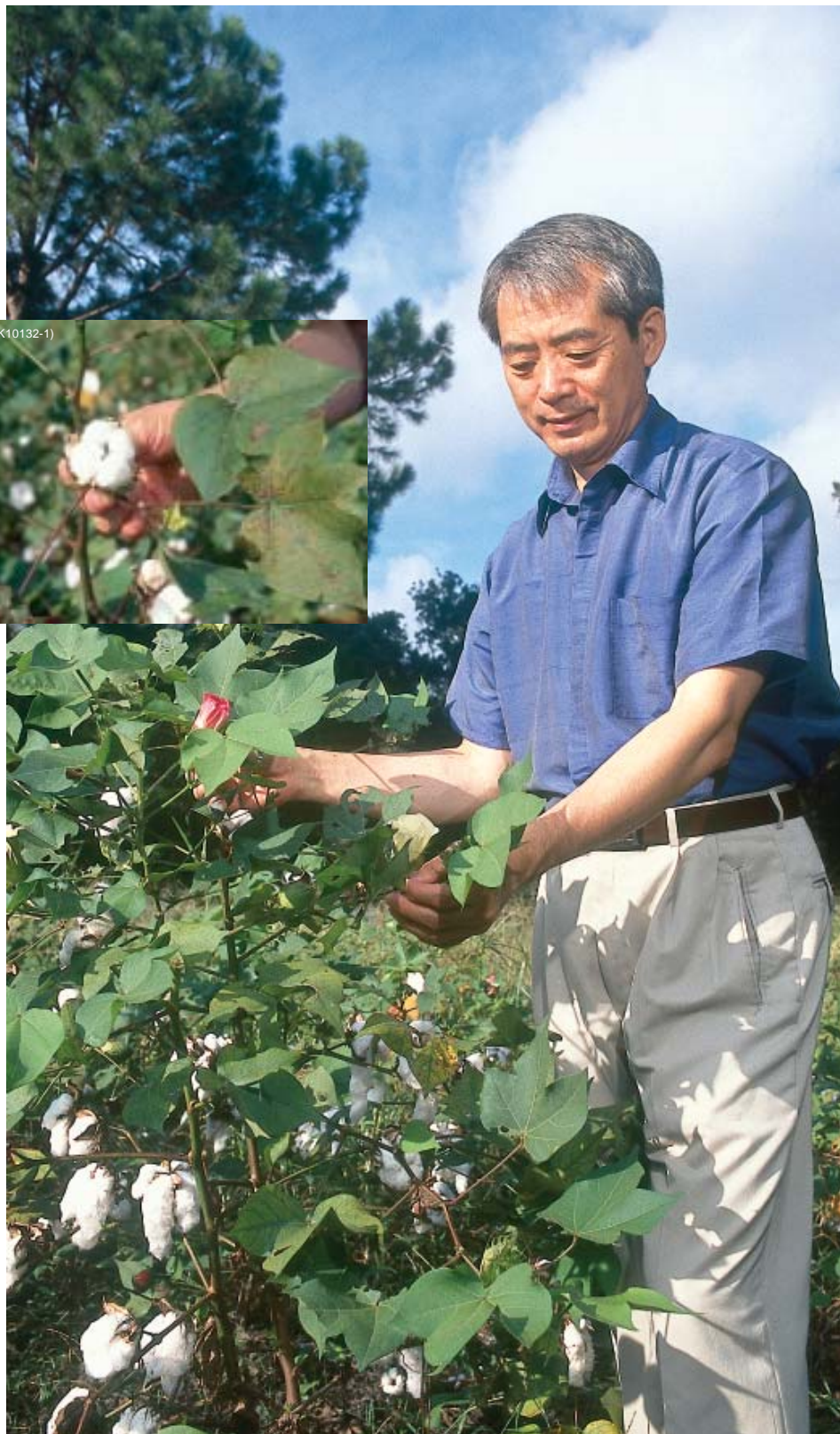
Martek has helped solve this problem. It is currently the only company with a DHA/ARA oil blend that has been approved for use in infant formula by the U.S. Food and Drug Administration. The blend makes up only a small percentage of the finished product, but its addition helps formula makers come closer to matching the profile of mothers’ milkfat.

Some research, including a study funded by the National Institute of Child Health and Human Development and published in *Developmental Medicine and Child Neurology* in 2000, has shown that babies fed infant formula supplemented with DHA and ARA perform better on mental and visual acuity tests than babies fed formula without these supplements. Several major baby-formula producers have licensed Martek’s algal oil, and it is used in products sold in 60 countries.—By **Amy Spillman, ARS.**

*This research is part of Quality and Utilization of Agricultural Products, an ARS National Program (#306) described on the World Wide Web at <http://www.nps.ars.usda.gov>.*

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Chemical engineer Peter Wan examines the flowers on a cotton plant. Inset: Close-up of a cotton boll, the source of fiber and cottonseed.